COLLECTIONS OF SAND FLIES (DIPTERA: PSYCHODIDAE) FROM MAMMAL BURROWS IN AN AREA OF CUTANEOUS LEISHMANIASIS IN CAMPECHE, MEXICO[1]

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ABSTRACT: Sand flies were caught from December 1993 to November 1994 in an endemic focus of cutaneous leishmaniasis in the state of Campeche, Mexico. A total of 566 sand flies of seven species were collected using emergence funnel-traps, at openings of several mammal burrows. The main species collected were *Lutzomyia deleoni* and *Brumptomyia hamata.* Population abundance was found bimodal with the first and higher peak from January to March. A small second peak was found from May to October.

Phlebotominae sand flies are small haematophagous insects, well known as vectors of human diseases such as bartonellosis, several arboviruses (mainly Bunyaviridae), and leishmaniases (Young and Duncan 1994). About 700 species of sand flies are known in the world in six genera: *Phlebotomus, Sergentomyia* and *Chinius* in the Old World, and *Lutzomyia, Brumptomyia* and *Warileya* in the New World. Transmission of *Leishmania* spp. (Kinetoplastida: Trypanosomatidae) is restricted to the genera *Phlebotomus* and *Lutzomyia* (Lane 1993).

Sand flies are mainly crepuscular and/or nocturnal. During day-time these phlebotomines rest in a wide variety of shelters such as rock crevices, tree-trunks, caves, underneath dead leaves and animal burrows (Adler and Theodor 1957, Minter 1982, Ward 1985). Such microhabitats might be breeding places.

Little is known in Mexico about the resting/breeding sites of sand flies. The aim of this study was to document the seasonal dynamics of sand flies collected from mammal burrows.

MATERIAL AND METHODS

Study site. The study site was 8 km southeast of the village of La Libertad, Campeche, Mexico. At this site the vegetation is classified as a subperennial tropical forest. In this area the weather is humid-dry with an annual mean tem-

[1] Received November 20. 1995. Accepted: May 20, 1996.

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perature of 27°C and an annual rainfall of 1400 mm (Flores and Espejel 1994).

Sampling of sand flies. Sand flies were caught each month from December 1993 to November 1994, except for September when floods made it impossible to reach the study area. Funnel-traps (Comer and Corn 1991) were placed at the entrance of mammal burrows, mainly armadillo *(Dasypus* sp.) and agouti *(Dasyprocta* sp.). Seventeen traps were set during nine consecutive nights each month. The traps were placed before dusk and checked either the following morning or every other day. Sand flies were manually separated from other insects after each collection using metal tweezers, and then preserved in small vials containing 70% ethanol.

Identification of sand flies. Once in the laboratory, the flies were mounted on microscope slides following the methodology of Young and Perkins (1984). Euparal® (Bioquip Products Co., Gardena CA) was used as mounting medium. Species determination was carried out using the keys of Forattini (1973), Young (1979), Murillo and Zeledon (1985), and Young and Duncan (1994). Gravid females (i.e., females with egg development in IV and/or V Christophers' stages) were easily detected during the identification process. Most mounted slides were kept as voucher specimens at the University of Yucatan (UADY) with some duplicates at the University of Nuevo Leon (UANL).

RESULTS AND DISCUSSION

Overall 566 sand flies, including two genera and seven species, were collected during 87 trapping-nights (Table 1). The most common species was *Lutzomyia deleoni* (Fairchild & Hertig) representing 72.09% of the total trap

Table I . Distribution of sand flies collected by funnel traps from mammal burrows in a subperennial tropical forest in the state of Campeche.

Species	Number of Female	Male	Total	%
B. galindoi	10	14	24	4 2
B. hamata	73	13	86	15.2
L. carpenteri	4	14	18	3 2
L. deleoni	220	188	408	72.1
L. o. olmeca	1	17	18	3 2
L. panamensis	2	0	2	0.4
L. shannoni	2	8	10	1.8
Total	312	254	566	100

ping. The test for sex ratio gave an equal proportion of female: male ($Z = 1.56$, $P > 0.05$). *L. deleoni* is mainly suspected to feed on mammals other than human. Williams (1968) reported this sand fly as an abundant species at ground level, being attracted to rodent-baited traps. The non-anthropophilic behavior of this species is supported by the scanty flies caught on human bait catches reported by Williams (1965), Porter *et al.* (1987), and Rowton *et al.* (1991).

The second most numerous species was *Brumptomyia hamata* (Fairchild & Hertig) constituting 15.2% of the total caught. The test for sex ratios indicated that more females were captured than males ($Z = 8.95$, $P < 0.01$). It is suggested that this species (as other members of the genus) might be associated with armadillo burrows from which the sand fly may obtain its blood meal (Young and Duncan 1994).

Other species such as *B. galindoi* (Fairchild & Hertig), *L. carpenteri* (Fairchild & Hertig), *L. o. olmeca* (Vargas & Diaz-Nájera), *L. panamiensis* (Shannon) and *L. shannoni* (Dyar) were also collected from the burrows (Table 1), but their numbers were too low to be considered for further analysis. In fact all these species pooled together represented only 12.7 % of the captures.

The monthly abundance of sand flies was bimodal. The first and the higher peak was found from January to March and it was composed mainly from *L. deleoni* catches. The second peak (May through October) was composed of both *L. deleoni* and *B. hamata*. Numbers of sand flies captured each month seem to be correlated with low levels of rainfall but the abundance of *B. hamata* increased during the period of heaviest rainfall (Fig 1). Reproductive seasons

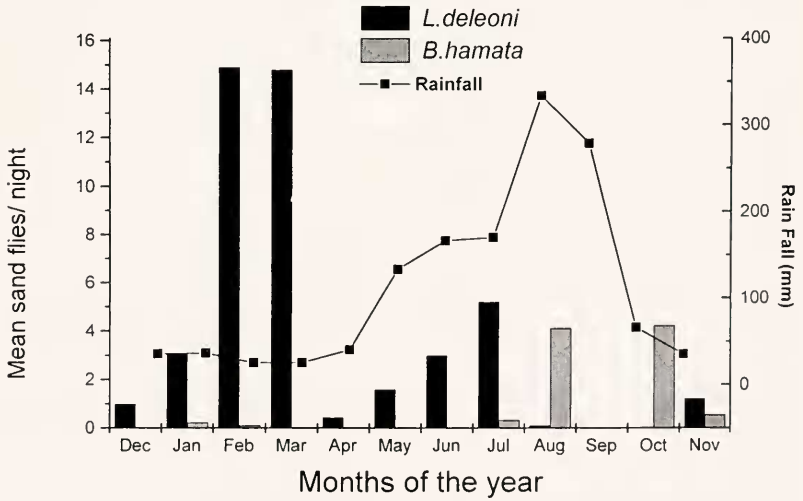

Figure 1. Abundance of sand flies collected in mammal burrows from December 1993 to November 1994 using funnel traps. Campeche state, Mexico.

for the major species may be determined by the number of gravid females caught each month. During the first peak 36 gravid *L. deleoni* females were caught while during the second peak 18 gravid females of the same species were recorded. Other gravid females found were *L. carpenteri* (2), *L. shannoni* (1), *B. hamata* (3), and *B. galindoi* (1).

Other authors (Fairchild and Harwood 1961, Thatcher and Hertig 1966, Chaniotis and Anderson 1968) have reported sand flies inhabiting mammal burrows in the New World, but the importance of such burrows is not yet well understood. We suggest that further studies are needed to determine whether those burrows serve as resting/breeding places or both.

ACKNOWLEDGMENTS

We are indebted to the inhabitants of La Libertad, Campeche, Mexico for their cooperation and to the authorities of the Regional Research Centre, University of Yucatan for providing facilities for field work. This project received financial support from UNDP/WORLD BANK/WHO Special Programme for Research and Training in Tropical Diseases (TDR) ID 900248.

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BOOK REVIEW

CADDISFLIES (TRICHOPTERA) OF THE INTERIOR HIGHLANDS OF NORTH AMERICA. S.R. Moulton II and K.S. Stewart. 1996. Memoirs of the American Entomological Institute, Volume 56, 313 pp.; ISBN: 1-887988-00-9. (Available from American Entomological Institute, 3005 SW 56th Avenue, Gainesville, FL 32608-5047. $40.

The Interior Highlands, a 400,000 km region in parts of Arkansas, Illinois, Missouri and Oklahoma have long been notable for their high numbers of endemic plants, insects and fishes. The first extensive study of aquatic insects in the region, which contains the Ozark, Arbuckle and Wichita Mountains, dates to 1991 with the publication of the monograph by Poulton and Stewart on the Plecoptera of the region. With the publication of this new monographic study by Moulton and Stewart on the Trichoptera of the Interior Highlands, we have a companion volume. Workers concerned with water quality and aquatic resources in the region will have monitoring tasks considerably easier with the coverage of two of three EPT groups. Caddisfly workers will find the book a worthy successor to Ross's classic 1944 survey of the Illinois fauna.

The book is basically divided into two sections; text and taxonomic keys. The text portion is subdivided into an introduction, which includes a summary of regional caddisfly studies, and a description of the geology and hydrology of the Interior Highlands. Following the introduction is a methods section which describes the nearly 500 localities in all 17 physiographic subregions visited between 1990 - 1994. The results section is one of the highlights of the book and contains extensive information on the distribution and emergence dates of the 229 species in 58 genera and 17 families identified from the 250,000 specimens collected during the study. Not too surprisingly, this caddisfly fauna was dominated by Hydroptilidae, Leptoceridae and Hydropsychidae. Detrended Correspondence Analysis was used to determine if species occurrence could be linked to habitat variables, watersheds or geology; the results of which are presented in an expansive table. Patterns of distribution, probable affinities and distribution maps for the 27 caddisflies endemic to the Interior Highlands are included, as is a brief discussion of another 13 species with disjunct distributions occurring in the region.

The second half of the book is devoted to a taxonomic treatment of the caddisflies in the Interior Highlands. Keys are available to family for both larvae and adults. Each family is covered individually with a summary of distinguishing characteristics and distribution. Each genus is then summarized briefly with species keys provided. These keys are primarily for adult males, although there are regional larval keys for 11 genera, including *Helicopsyche*, *Ceratopsyche*, *Hydropsyche*, and *Rhyacophila*. The illustrations accompanying the keys are another of the book's highlights.

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